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Claims

[c1] An apparatus for reducing the post-detonation pressure of a perforating gun, the apparatus comprising:
a perforating gun carrying at least one explosive charge, wherein when the explosive charge is detonated the explosive charge produces a pressurized detonation gas;
a pressure reducer in functional connection with the perforating gun, the pressure reducer adapted to reduce the pressure of the detonation gas.

[c2] The apparatus of claim 1 wherein the pressure reducer is positioned proximate the perforating gun.

[c3] The apparatus of claim 1 wherein the pressure reducer is positioned disposed in the perforating gun.

[c4] The apparatus of claim 1 wherein the pressure reducer is part of the perforating gun.

[c5] The apparatus of claim 1 wherein the pressure reducer includes a heat sink adapted for rapidly reducing the temperature of the detonation gas.

[c6] The apparatus of claim 5 wherein the heat sink has a high thermal conductivity.

[c7] The apparatus of claim 5 wherein the heat sink has a large heat capacity.

[c8] The apparatus of claim 5 wherein the heat sink includes copper.

[c9] The apparatus of claim 5 wherein the heat sink includes water.

[c10] The apparatus of claim 5 wherein the heat sink includes microencapsulated water beads.

[c11] The apparatus of claim 1 wherein the pressure reducer includes a reactant adapted for recombining with the detonation gas to reduce the molar density of the detonation gas.

[c12] The apparatus of claim 11 wherein in the reactant is selected from the group consisting of Al, Ca, Li, Mg, Ta, Ti, Zr, and combinations thereof.

[c13] The apparatus of claim 1 wherein the pressure reducer includes a pressure compression section in functional connection with a gun.

[c14] The apparatus of claim 13 wherein the compression section includes a compressible material.

[c15] The apparatus of claim 14 wherein the compressible ma-

terial is a spring.

[c16] The apparatus of claim 14 wherein the compressible material is a solid.

[c17] The apparatus of claim 14 wherein the compressible material is a fluid.

[c18] The apparatus of claim 5 wherein the pressure reducer is positioned proximate the perforating gun.

[c19] The apparatus of claim 11 wherein the pressure reducer is positioned proximate the perforating gun.

[c20] The apparatus of claim 14 wherein the pressure reducer is positioned proximate the perforating gun.

[c21] The apparatus of claim 5 wherein the pressure reducer is positioned disposed in the perforating gun.

[c22] The apparatus of claim 11 wherein the pressure reducer is positioned disposed in the perforating gun.

[c23] The apparatus of claim 14 wherein the pressure reducer is positioned disposed in the perforating gun.

[c24] The apparatus of claim 51 wherein the pressure reducer is part of the perforating gun.

[c25] The apparatus of claim 11 wherein the pressure reducer

is part of the perforating gun.

[c26] The apparatus of claim 14 wherein the pressure reducer is part of the perforating gun.

[c27] An apparatus for reducing the post-detonation pressure of a perforating gun, the apparatus comprising:
a perforating gun carrying at least one explosive charge, wherein when the explosive charge is detonated the explosive charge produces a pressurized detonation gas;
a temperature reducer in functional connection with the perforating gun, the temperature reducer adapted for reducing the temperature of the detonation gas; and
a molar density reducer in functional connection with the perforating gun, the molar density reducer adapted for reducing the molar density of the detonation gas.

[c28] The apparatus of claim 37 wherein the temperature reducer is positioned The apparatus of claim 37 wherein the temperature reducer is positioned

[c29] The apparatus of claim 37 wherein the temperature reducer is positioned in the perforating gun.

[c30] The apparatus of claim 37 wherein the temperature reducer is part of the perforating gun.

[c31] The apparatus of claim 37 wherein the molar density re-

ducer is positioned proximate the perforating gun.

[c32] The apparatus of claim 37 wherein the molar density reducer is positioned in the perforating gun.

[c33] The apparatus of claim 37 wherein the molar density reducer is part of the perforating gun.

[c34] The apparatus of claim 27 wherein the temperature reducer includes a heat sink adapted for rapidly reducing the temperature of the detonation gas.

[c35] The apparatus of claim 34 wherein the heat sink has a high thermal conductivity.

[c36] The apparatus of claim 34 wherein the heat sink has a large heat capacity.

[c37] The apparatus of claim 34 wherein the heat sink includes copper.

[c38] The apparatus of claim 34 wherein the heat sink includes water.

[c39] The apparatus of claim 34 wherein the heat sink includes microencapsulated water beads.

[c40] The apparatus of claim 27 wherein the molar density reducer is a reactant adapted for recombining with the detonation gas to form solids.

[c41] The apparatus of claim 34 wherein the molar density reducer is a reactant adapted for recombining with the detonation gas to form solids.

[c42] The apparatus of claim 27 wherein the temperature reducer and the molar density reducer include a pressure compression section in functional connection with a gun chamber.

[c43] The apparatus of claim 42 wherein the compression section includes a compressible material.

[c44] The apparatus of claim 40 wherein the temperature reducer and the molar density reducer include a pressure compression section in functional connection with a gun chamber.

[c45] The apparatus of claim 41 wherein the temperature reducer and the molar density reducer include a pressure compression section in functional connection with a gun chamber.

[c46] A method of reducing the post-detonation pressure of a perforating gun comprising the steps of:
providing a perforating gun having explosive charges;
detonating the explosive charges producing a pressurized detonation gas; and

reducing the detonation gas pressure proximate the perforating gun to encourage a surge flow from a reservoir formation.

[c47] The method of claim 46 wherein the detonation gas pressure is reduced by rapidly reducing the temperature of the detonation gas.

[c48] The method of claim 46 wherein the detonation gas pressure is reduced by reducing the molar density of the detonation gas.

[c49] The method of claim 47 wherein the detonation gas pressure is reduced by reducing the molar density of the detonation gas.

[c50] The method of claim 46 wherein the step of reducing the detonation gas pressure includes providing a heat sink in functional connection with the perforating gun adapted for reducing the temperature of the detonation gas.

[c51] The method of claim 46 wherein the step of reducing the gas pressure includes the providing a compression section in functional connection with the perforating gun for reducing the pressure of the detonation gas.

[c52] The method of claim 46 wherein including the step of reducing the gas pressure includes providing a reactant

adapted for recombining with the detonation gas to form solids.

[c53] The method of claim 50 wherein the heat sink includes copper.

[c54] The method of claim 50 wherein the heat sink includes water.

[c55] The method of claim 51 wherein the compression section includes a compressible spring.

[c56] The method of claim 51 wherein the compression section includes a compressible fluid.

[c57] The method of claim 51 wherein the compression section includes a compressible solid.

[c58] The method of claim 51 wherein in the reactant is selected from the group consisting of Al, Ca, Li, Mg, Ta, Ti, Zr, and combinations thereof.